

Chapter 3

Asphalt Pavement Program

3.0 Introduction

Description

Maintenance plays an essential and integral role in the long-term life of a pavement. Pavement left to deteriorate without timely maintenance treatment will likely require more costly treatments sooner than those properly maintained. MDT's asphalt pavement program includes those pavements surfaced with bituminous surfacing.

Purpose

This chapter describes the following maintenance activities:

- Milling
- Base surface repair
- Spot overlay
- Rut fill
- Contracted Overlays
- Hand Patching
- Seal Coats including Spot Sealing, Fog Sealing, and Sand Sealing
- Chip Seals
- Crack Filling/Crack Sealing/Contracted Crack Sealing

MDT's goal is to maintain asphalt pavements in a manner that provides a safe roadway, preserves and extends the state's investment, maintains the functional condition and retards future deterioration by providing the appropriate treatment at the right time.

Pavement Management

Pavement maintenance is classified by function as either reactive or preventive. The difference between the two is the condition of the pavement at the time the treatment is applied.

Preventive maintenance treatments preserve rather than improve the structural capacity of the pavement. Preventive maintenance treatments are limited to pavements that meet certain conditional requirements as defined by the Pavement Management System report. MDT's Pavement Management System (PvMS) identifies those projects available for preventive maintenance by three strategies: crack seal, chip seal, and thin overlay.

The goal of reactive maintenance is to maintain the roadway until the construction program can reconstruct or rehabilitate the project. Generally, hand patching, a thin

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overlay in spot locations or long projects and rut fill with a chip seal are used as a reactive maintenance treatment.

When developing an asphalt pavement program, the following factors should be considered:

- Budget limitations (state and federal).
- Optimizing both preventive and reactive maintenance available funds.
- Available construction projects in the area on which to piggy back.
- Pavement's distress and ride quality.
- Pavement distresses affecting safety.
- Best strategies to preserve the state's investment.
- Cost/Benefit of the treatment.
- Average Daily Traffic (ADT).

Pavement Deficiencies

Pavement deficiencies or distresses, affecting safety and having a long-term effect on the pavement and ride quality, should be considered when establishing a maintenance asphalt pavement program. The following pavement distresses should be considered when establishing a long-term pavement maintenance program.

- **Rutting or Shoving**

Rutting, shoving or other surface distortions are generally a result of unstable bituminous surfacing, poor quality plant mix or an unstable base material. Unstable bituminous surfacing is usually the result of excessive asphalt, inadequate voids in the mix or aggregate, which is susceptible to striping.

Corrective measures may include cold milling the surface, or placing bituminous surfacing to fill rutted areas. Either a motor patrol or a rut filler attachment can be used in placing mix on the rutted areas. The strategy should be based on the cause and extent of the distress.

- **Raveling**

Raveling usually results from a dry plant mix or an oxidized surface. Corrective measures may include fog sealing, chip sealing and for severe raveling, placing a bituminous overlay. All seals add asphalt to the surface to minimize additional raveling. The seal selected for a particular section should be based on the condition of the roadway surface, age of the pavement, and traffic.

- **Slippery Pavement**

Slippery conditions or skid-resistance problems may occur on pavement surfaces that have become smooth as a result of excess asphalt, wear or dense surface texture.

Corrective measures may include milling the pavement surface or placing a chip seal. For flushed or bleeding pavements, lime or lime sand mixture should be

used during extremely hot weather conditions to blot the excess asphalt. However, this is only a temporary measure.

- **Miscellaneous Cracking**

Miscellaneous cracking is non-load related. Examples of miscellaneous cracks include transverse, block, and longitudinal cracks. The Miscellaneous Cracking Index (MCI) is identified in the PvMS. Brittleness of the surface, expansion and contraction due to temperature changes and/or the presence of moisture in the pavement's structure generally cause these types of pavement cracks. Corrective measures may include crack sealing, chip sealing, or applying thin overlay, depending on the extent and severity of the distress.

- **Alligator Fatigue Cracking**

Alligator cracking are those cracks that are load or fatigue related identified in the PvMS. Alligator cracks occur in the wheel path and then progress in a "chicken wire" appearance. Alligator Cracking Index (ACI) is identified in the PvMS. Isolated areas of alligator cracking can be a result of a saturated sub grade or base and may require a dig-out to correct.

Corrective measures may include crack sealing the initial longitudinal cracks. However, this is only a temporary fix. A thin overlay is a strategy that provides long-term repair. Alligator cracking should be overlaid as early as possible to maximize the longevity of the overlay.

- **Potholes**

Potholes result from a combination of moisture in or under the pavement and of wheel load from traffic. Freeze-thaw cycles and truck traffic accelerate the development of potholes.

Corrective measures may include machine or hand patching, overlaying with bituminous surfacing, chip sealing or correcting inadequate drainage.

Purchasing

Arrangements for obtaining the required materials should be made prior to scheduling a project. Development of a **Pavement Preservation Contract** for asphalt mix material requires a minimum of two months prior to the project. **The Pavement Preservation Contract** has provisions for laid-in-place paving, contractor mixing and asphalt mixing on an as needed basis.

Liquid asphalt materials are purchased for each maintenance area through a yearly contract. Performance Graded (PG) asphalts are not part of the yearly contract, but are included in the specific project's **Pavement Preservation Contract**.

Crack sealant materials are purchased twice a year for each maintenance area. Crack sealant for contractor crack sealing projects is part of the contract and is not furnished by MDT. Winter patching materials are purchased through a yearly contract.

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Safety and Training

Supervisors should review safety, training and work zone requirements with employees to ensure compliance with approved guidelines.

Employees should review all Material Safety Data Sheets (MSDS) to learn about products and to make themselves aware of safety and health precautions and required personal protective clothing.

Environmental Best Management Practices

Supervisors should be aware of environmental concerns. Special precaution must be taken to protect water quality near streams, lakes and wetlands. Dispose of waste at an appropriate site.

Documentation

Documentation of these activities should be in accordance with activity reporting system outlined in the Maintenance Management System Manual of Instructions. If special documentation is required, it will be included under the application activity.

Resources

[MDT Safety Policy and Procedures Manual](#)

[Material Safety Data Sheets](#)

[MMS Manual](#)

[Pavement Management System Handbook](#)

[Annual Pavement Management System Report](#)

[Crack Seal Manual](#)

[MUTCD](#)

[Section 701-Standard Specification for Road and Bridge Construction Manual](#)

[Maintenance Chip Seal Manual](#)

[Work Zone Guidelines](#)

[Materials Manual](#)

[Flaggers Manual](#)

3.1 Base and Surface Repair (MMS 1109)

Activity Description

This activity is used when distress in pavement originates in the base material. This activity includes the removal of small areas of bituminous roadway. Repairs include replacement of base material with appropriate aggregate and an adequate depth of bituminous material.

Purpose

The purpose of this activity is to maintain the roadway surface.

Timing of Maintenance

Periodic inspections should be made of roadway surfaces to determine locations and extent of base failures. When base materials begin to affect the riding quality and structural integrity of the surfacing, the areas should be removed and replaced. If repairs cannot be completed within a reasonable time frame, warnings should be posted as appropriate.

Specialized Equipment

- Traffic control devices
- Pavement cutter
- Hand tools – tampers, plate compactors, etc.
- Emulsion for tack and broom for application
- Tamper or roller for compacting
- Trailer for roller

Materials

- Type A Gravel
- Pit run
- Locally Purchased Asphalt Material
- Cement
- Millings

Safety and Training

Supervisors should review safety, training and work zone requirements with employees and ensure compliance with approved guidelines. Reference: MDT Safety Policy and Procedures Manual-Maintenance Section.

Environmental Best Management Practices

Best management practices for surface and shoulder activity types:

- Carry adequate erosion control supplies (diapers, kitty litter, shovels and etc.) to keep materials out of water bodies.

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- Dispose excess material at a site appropriate for the material. When possible, perform surface work in dry weather to minimize any runoff of hazardous material.

Procedure

1. Set up appropriate traffic control.
2. Cut the pavement outside of the distressed area using asphalt cutter or other equipment.
3. Remove failed asphalt surfacing and base material.
4. Prepare sub-grade. If appropriate, use fabric. Aggregate used for replacement of sub grade material should be of appropriate size and gradation to provide the strengths required for a successful repair. Simply using pit run materials to completely refill the dig out area may result in a weak sub grade in the repair area.
5. Place base material in uniform horizontal layers not exceeding eight (8) inches (20 cm) in loose thickness before compaction. Each layer of material should be moistened as necessary and thoroughly compacted.
6. Apply prime coat using liquid asphalt.
7. Return and level with surface material as described in Activity 1101 or 1102.
8. Make a reasonable effort to return to original design standards.

3.2 Surface Patching-Hand (MMS 1101)

Activity Description

This activity is used for filling in potholes by hand. This includes restoration of lost surface from potholing, raveling and other causes. Bituminous surfacing is placed with hand tools. Plant mix is the preferred material.

Permanent patches are the standard and should be placed when practical. Temporary patches may be used during cold/wet weather or when time does not permit permanent repair. Temporary patches may be made with premixed liquid asphalt bituminous surfacing or special proprietary mixes that do not require a pothole to be dry or primed. The more expensive special mixes are appropriate in certain situations and tend to be more effective in wet conditions.

Purpose

The purpose of this activity is to maintain the surface of the highway for motorists' safety and acceptable quality ride.

Timing of Maintenance

Potholes need to be repaired promptly. If weather or other priorities prohibit repair of potholes, warning signs should be posted.

Specialized Equipment

- Jack hammer
- Pavement cutter
- Emulsion and broom for tack application
- Tamper or roller for compacting
- Trailer
- Pressure/jack hammer

Materials

A variety of materials can be used for patching: plant mix asphalt cement, emulsions and proprietary (cold weather) mixes. The choice of materials is dependent on distance from the source of materials to the job, time of year and the size of the job.

- Permanent patching requires emulsion for tacking the pothole and sealing the patch.
- Plant-mixed asphalt cement (AC) must be in place and compacted before it cools. Covering loads of this material will help keep it hot if a long distance haul is involved. AC mixes cannot be stored in stockpiles. They can be purchased from local hot plants on an as needed or on a contract basis.
- Mixing contracts are typically let for each Area to have cold-plant blend using cut back asphalts. These materials can be stored outside and used as needed.
- Proprietary (cold weather) mixes or blends are let through contracts and are blended at the hot plants.

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Storage

Blended cold piles using cutback are stored outside and used as needed.
Proprietary mixes should be stored inside.

Safety and Training

Supervisors should review safety, training and work zone requirements with employees and ensure compliance with approved guidelines.

Employees should review MSDS to learn about the product and to make themselves aware of safety and health precautions and required personal protective equipment and clothes.

Environmental Best Management Practices

Best management practices for surface and shoulder activity types:

- Use environmental sensitive cleaning agents.
- Carry adequate erosion control supplies (diapers, kitty litter, shovels and etc.) to keep materials out of water bodies.
- Dispose excess materials at an appropriate site.
- Perform surface work, when possible, in dry weather to minimize any runoff of hazardous materials.
- Use commercial asphalt plants for asphalt, if possible and where economically feasible.

Procedures

Note: When numerous potholes develop and patching operations are delayed, appropriate warning signs should be placed.

Prior to work, put in place the appropriate traffic controls.

Permanent Patches Procedures

1. Remove unsound pavement resulting in a clean area with vertical sides, using jackhammer, pavement wheel cutter, pavement saw, or other tools. Materials in shoved areas must be removed prior to repair.
2. If base materials are being added prior to asphalt mix, every four (4) inches (100 mm) lift should be compacted using appropriate methods. The sides should be primed or tacked. Tacking the bottom is not necessary.
3. The asphalt aggregate mix is then placed in the hole and compacted with appropriate methods depending on the size of the repair. Make allowance for compaction that will permit the finished surface of the patch to be flush or just slightly above the surrounding surface. As a general rule, premixed asphalt paving material will compact $\frac{1}{4}$ inch (6.35 mm) for each one (1) inch (25.4 mm) of loosely placed thickness.

4. When the repairs are complete and equipment is off the road, pick up the traffic control devices in reverse order of installation.

Small patches are repaired by hand. For larger patches, it may be more effective to use a motor patrol. Consider sealing patches with an emulsion and possibly an aggregate prior to winter.

Temporary Cold Weather Patches

During periods of cold, wet or inclement weather, potholes can be patched with special winter mixes. The special mixes do not require that the potholes be dry, clean or primed. Fill the pothole with special mix and compact. Make allowance for compacting that will permit the finished surface of the patch to be flush or just slightly above the surrounding surface. As a general rule, premixed asphalt paving material will compact ¼ inch (6.25 mm) for each 1 inch (25.4 mm) of loosely placed thickness. Though more expensive than a normal stockpiled premix material, special mixes reduce patching costs because they stay in the potholes much longer. This material is not appropriate for larger patching such as blade patching.

Temporary Patches Procedures

1. Prepare the area to be patched by removing all loose materials.
2. Shape the area evenly with vertical edges and sides.
3. The bottom and sides should be primed or tacked. For priming, use either liquid or emulsified asphalt.
4. Place the asphalt aggregate mix in the hole and compact with truck tires or plate compactor. Make allowance for compaction that will permit the finished surface of the patch to be flush or just slightly above the surrounding surface. As a general rule, premixed asphalt paving material will compact ¼ inch (6.25 mm) for each 1 inch (25.4 mm) of loosely placed thickness.

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3.3 Machine Patching (MMS 1102)

Activity Description

This activity is for restoring the pavement surface because of potholes, settlements and other pavement distresses.

Hot or cold asphalt mix or recycled asphalt pavement (RAP) mix material may be used for this activity. RAP materials may require a mix design to identify a specific type of oil to be used and the amount of oil needed per ton. The exact type of material and type of lay down machine used should depend on the extent and severity of the pavement distress, ADT, budget limitations and other factors.

Machine patching lift thickness should be limited to a thickness appropriate to ensure best compaction. As a general guideline, machine patching with motor patrol should be limited to 1000 feet or shorter segments of the roadway. Longer segments should use a paver or the rut filler attachment. Exceptions to this guideline should be considered on an individual project basis.

Purpose

The goal of this activity is to maintain the highway surface in a condition that provides reasonable safety, preserves the state's capital investment and provides an acceptable ride quality.

Timing of Maintenance

Machine patching should be performed when the ride is undesirable or large areas are distressed to the point beyond hand patching.

Specialized Equipment

- Paver
- Rut filler attachment
- Roller of appropriate size. Depending on the repair, a pneumatic or steel wheel roller is acceptable.

Materials

All mixes must meet the terms of the contract for plant mix and be purchased through a commercial source. Typical materials include the following:

- SS-1or equivalent
- Hot asphalt mix
- Cold mix
- RAP (millings)

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The choice of materials is dependent on distance from the source of materials to the job, time of the year, anticipated durability requirements, funding available and the size of the job.

- Permanent patching requires emulsion for tacking the pothole and sealing the patch.
- Hot-mixed asphalt cement must be in place and compacted before it cools. Covering loads of the mix will help keep it hot if a long distance haul is involved. The mixes cannot be stored in stockpiles. They can be purchased from local hot plants on an as needed or contract basis.
- Mixing contracts are typically let for each Area to have cold-plant blended using cut back asphalts. These materials can be stored outside and used as needed.

RAP/Millings can be prepared for use in three different ways:

- Millings can be wind rowed, shot with emulsion and laid with a motor patrol.
- Millings can be run through a pug mill resulting in a more thorough mixing of asphalt then laid with a motor patrol.
- Millings can also be run through a hot plant with a mix design and laid with a paver.

Testing and Sampling

All bituminous materials used for making asphalt mix material must be sampled and tested. Two asphalt samples shall be obtained from every truck and trailer load. The asphalt transport driver shall take the samples. **MDT personnel should not take the samples.**

All samples are to be labeled with appropriate information, including the cost center number identifying the project. Submit samples to the Materials Bureau in Helena as soon as possible, preferably the next day

Storage

Blended cold piles using cutback asphalt (MCs) and emulsions can be stored at approved sites. They are stored as according to the guidelines outlined by the manufacturer. All aggregates and cold mix stockpiles should be in locations that have good drainage and are free of contaminants or noxious weeds.

Special Handling

Hot asphalt mix material that must be hauled long distances or stored at the work site for extended periods of time, may need to be covered to maintain its workability. When it is placed with a motor patrol, it must be spread and compacted quickly before it cools and becomes difficult to work.

Safety and Training

Supervisors should review safety, training and work zone requirements with employees and ensure compliance with approved guidelines.

Employees should review MSDS to learn about the product and to make themselves aware of safety and health precautions and required personal protective equipment and clothes.

Environmental Best Management Practices

Best management practices include:

- Locating stockpiles away from rivers and streams.
- Striving to eliminate diesel and solvents as a releasing and cleaning agent by using environmentally sensitive cleaning and releasing agents.
- Carrying adequate erosion control supplies (diapers, kitty litter, shovels, etc.) to keep materials out of water bodies.
- Performing surface work in dry weather to minimize any runoff of hazardous material when possible.
- Disposing excess materials at sites appropriate for the material.
- Ensuring that the contractors and MDT staff, who fuel and operate asphalt plants, have an adequate spill plan and materials for spill containment if possible.
- Establishing mixing plants outside of riparian corridors. The Maintenance Chief in cooperation with the MDT District Biologist should review site location.

Procedures

Machine patching uses hot asphalt mix material under the following conditions:

- The surface temperature is at least 35°F (2°C) and rising.
- The surface is dry and clean.

Machine patching uses cold asphalt mix or cold RAP/milling material under the following conditions:

- The surface temperature is at least 65°F (18°C) and the ambient temperature has not been below 40°F (3°C) (during the preceding 24 hours).
 - The surface is clean and dry.
1. Set up traffic control, possibly including arrow boards, changeable message signs, pilot vehicles and flagger stations as required by the work zone guidelines. (Subsequently, this procedure will be referred to as traffic control)
 2. Prepare area to be patched. (Sweep if necessary to remove loose material.)
 3. Apply an emulsion tack.
 4. Place bituminous surfacing with rut filler attachment, a paving machine or a motor patrol.
 5. Roll patch with appropriate roller (one pneumatic or one steel-wheeled roller are recommended.)
 6. Clean up area and dispose of waste at a designated site.
 7. Place temporary pavement markings over the patched area. Follow as soon as possible with permanent pavement markings.
 8. Warning signs such as “fresh oil” or “loose gravel” should be placed where appropriate.
 9. Remove traffic control.

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3.4 Crack Sealing/Joint Filling (MMS 1103)

Activity Description

This activity covers routing, cleaning and sealing/filling cracks in the pavement surface. Depth may vary depending on chip depth and age of chip seal. The goal is to route through the chip seal. Cracks are to be filled using an MDT-approved, rubberized crack sealant. Cracks, other than preventive maintenance projects, may be filled with rubberized sealant, cold pour or liquid asphalt and do not require routing. (Refer to Crack Seal Manual)

Purpose

Pavement cracks are sealed or filled to prevent moisture from entering the pavement and base. Moisture in the pavement base or sub-grade accelerates deterioration of the pavement.

Timing of Maintenance

Overlays and new pavement surfaces should be considered for a crack seal project every third year following completion of the project. District personnel should assess the crack sealing needs in their areas using the **Pavement Management System** and visual analysis.

The following guidelines are provided for selection of crack seal candidates:

- The MDT Pavement Management Section distributes an annual report that shows segments recommended for crack seal.
- Miscellaneous Cracking Index scores between 70-95 represent a good potential candidate for crack sealing, provided there is no significant load-related distress (alligator cracking or rutting) present.
- All crack seal candidates should be carefully field-reviewed before the final selection is made.
- If the pavement exhibits block or alligator base cracking, the procedure described below should not be used. Crack filler such as CRF-PM (cold pour) or other maintenance treatments are recommended where extensive cracking is present.
- Cracks should be sealed at least 60 days prior to placement of a chip seal.

Specialized Equipment

- A mechanical router for routing the cracks.
- An air compressor with nozzle to clean and dry cracks, with at least 100 CFM and 125 PSI.
- A hot air lance for drying the crack (optional).
- A pot or kettle capable of heating rubberized sealant to 400° F.
- Broom or blower to clean roadway.

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Materials

Sealant Specifications:

The product provided as a result of an award bid shall meet or exceed the capability and testing specification requirements. Each lot of material received should be sampled and submitted for testing.

All crack sealing on preventive maintenance projects shall be routed using 4 to 1 method, typically 1 ½ inches x 3/8 inches (40mm x 10mm).

For crack sealing, other than preventive maintenance projects, the following materials may be used:

- Rubberized sealant
- Liquid asphalt
- Rejuvenation agent
- Cold pour

In choosing a reactive crack seal product, consideration must be given to the characteristics of the material and potential effects to future repairs to the surface.

If field samples need to be taken, they are to be labeled with appropriate information, including the cost center number identifying the project. Submit samples to the Materials Bureau in Helena as soon as possible.

Storage

Rubberized crack sealant materials should be stored in a covered area. For a short period, it may be stored outdoors. Caution should be taken to ensure the product is not contaminated. Covered storage minimizes slumping of the materials, which occurs when it is stored in the sun for an extended period of time.

Safety and Training

Supervisors should review safety, training and work zone requirements with employees and ensure compliance with approved guidelines.

Employees should review MSDS to learn about the products and to make themselves aware of safety and health precautions and required personal protective equipment and clothing.

Special Precautions

Since rubberized crack sealant is placed at a very high temperature (over 380° F), this activity requires special precautions:

- Ensure first aid supplies are on the job site.
- Be careful of hot material splashing when filling the pot or kettle.
- Keep the crack-filling kettle outside in an open area when heating.
- Ensure the crack-filling kettle is always attended while heating.
- Perform daily safety inspections of the hose through which the material is applied.

- Be cautious when using the hot air lance due to high temperatures.
- Wear appropriate personal protective gear such as gloves, long sleeve shirts or coats, safety boots and eye protection.

Environmental Best Management Practices

Environmental best management practices include:

- Striving to eliminate diesel and solvents as a releasing or cleaning agent by using environmentally sensitive cleaning and releasing agents.
- Carrying adequate erosion control supplies (diapers, kitty litter, shovels etc) to keep materials out of water bodies.
- Disposing excess materials at sites appropriate for the materials.

Procedures

1. Purchase crack sealant through semi-annual contract.
2. Obtain sufficient crack sealant material for the day's production.
3. Check to ensure the pot or kettle is in good working condition.
4. Heat the crack filling material prior to the scheduled work.
5. Set up traffic control.
6. The pavement mat temperature must be at least 35° F. (2 °C.) and no more than 120° F (49°C) during the routing and crack sealing process. All working cracks between 1/8 inch (3 mm) and 1 inch (25 mm) will be routed to 1 ½ inch (40 mm) by 3/8 inch (10 mm) deep (4 to 1). The walls (sides of the routed reservoir) shall be vertical and the bottom flat. Cracks greater than 1 inch wide do not require routing and backer-rod may be necessary. However, all other parts of these guidelines shall apply. Non-working longitudinal cracks may use other crack sealing techniques and materials.
7. Clean all cracks with an air compressor before the sealant is applied, to be free of dirt, dust, or other loose material.
8. Fill the routed reservoir flush with the pavement surface (not band-aided). Do not overfill and keep the material from being spread widely on the pavement surface. Use a special tip on the filler tube to level material. Both the roadway and the sealed reservoirs shall be free of moisture. Both the roadway and the routed reservoir shall be free of moisture for a minimum of 1 hour before the sealant is applied.
9. Use a blotter material, if necessary, to eliminate tracking. Toilet paper (biodegradable), soap and water, or Glenzoil, may be used as a blotter.
10. Clean up the area, pick up all empty containers.
11. Remove traffic control by reversing the process used to set up the control.

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3.5 Rut Filling (MMS 1105)

Activity Description

This activity is for restoring the pavement surface (because of rutting) using rut-filling machines. Hot material should be used for this activity. Scarification of ridges should be considered on any rut fill project. Milling might be an option in cases of severe rut depths. Chip seal should be placed to complete the rut fill project. (See Section 3.9)

Purpose

The purpose of this activity is to maintain the highway surface in a condition that provides reasonable safety, preserves the state's capital investment and provides an acceptable ride quality.

Timing of Maintenance

Rut filling should be performed when the ruts in pavement create a significant potential safety hazard.

Specialized Equipment

- Rut filler attachment
- Pneumatic or steel wheeled roller
- Broom
- Distributor
- Haul equipment.

Application of Materials

When applying hot asphalt mix, the following guidelines should be followed:

- All mixes must meet the terms of the contract for plant mix material and purchased from a commercial source.
- Asphalt used as the binder should be PG asphalt.
- Introduction of lime in the asphalt mix may be required by the mix design.
- Apply a tack coat before placing the asphalt mix material (SS-1 or equivalent).
- Asphalt mix material discharge temperatures should conform to the recommended temperature in the mix design.
- Compaction effort should be completed before temperatures reach 175° F (79.4°C).

Testing and Sampling

All bituminous materials used for making asphalt mix material must be sampled and tested. Two samples from every load shall be taken and then sent to the Materials Bureau for testing. The hauler of the bituminous materials takes all samples. **MDT personnel must witness the sampling but should NOT take the sample.**

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Storage

Asphalt mixes cannot be stored for any extended periods or allowed to cool substantially. The spray temperatures for asphalt cement outlined in the mix design shall be followed. Cutback asphalt (MC's) can be stored at approved sites. Store according to guidelines outlined by manufacturer. All aggregate and cold mix stockpiles should be in locations that have good drainage, don't create a safety or traffic hazard and are free from contaminants.

Special Handling

Asphalt mix material, which must be hauled long distances or sit at the work site for extended periods of time, may need to be covered to maintain its workability. It must be spread and compacted quickly before it cools and becomes difficult to work.

Safety and Training

Supervisors should review safety, training and work zone requirements with employees and ensure compliance with approved guidelines.

Employees should review the MSDS to learn about products and to make themselves aware of safety and health precaution and required personal protective equipment and clothing.

Environmental Best Management Practices

Best management practices include:

- Striving to eliminate diesel and solvents as a releasing or cleaning agent by using environmentally sensitive agents.
- Carrying adequate erosion control supplies (diapers, kitty litter, shovels etc) to keep materials out of water bodies.
- Disposing excess materials at appropriate sites.
- Performing surface work in dry weather minimizing runoff of potentially hazardous material when possible.
- Ensuring that contractors and MDT staff who fuel and operate asphalt plants have an adequate spill plan and materials for spill containment if possible.
- Ensuring contractors establish mixing plants outside of riparian corridors. The Maintenance Chief in cooperation with the MDT District Biologist should review site location.

Procedure

The surface temperature must be at least 35° F (2°C) and the surface is dry and clean.

1. Set up traffic control, possibly including arrow boards, changeable message signs and flagger stations, as required.
2. Prepare rut to be filled. Sweep, if necessary, to remove loose materials.
3. Apply an emulsion tack.
4. Place bituminous surfacing with rut filler attachment.
5. Roll rut fill material with appropriate roller (one pneumatic or steel-wheeled roller).

6. Clean up area and dispose waste at a designated site.
7. Place temporary pavement markings on rut-filled area and place permanent markings as soon as possible.
8. Remove traffic control by reversing the process used to setup the controls.

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3.6 Chip Seal (MMS 1106)

Activity Description

Chip sealing is the controlled application to a highway surface of liquid asphalt followed immediately with an aggregate cover. Chip seals can be applied to a roadway surface as a preventive maintenance treatment to extend the life of the surface. A chip seal follows all new asphalt pavement overlays. (Refer to MDT Chip Seal Manual.)

Purpose

The purpose of the chip sealing is to improve friction on the surface, waterproof the surface, retard surface deterioration and provide a wearing course.

Timing of Maintenance

Chip seals should be completed every 5-7 years depending on the pavement condition or after a new overlay.

Specialized Equipment

- A self-propelled chip spreader calibrated to ensure a uniform application of chips across the width of the machine.
- Hauling equipment checked for general condition to ensure that they will hook up properly to the chip spreader and that they will dump into the hopper without spilling material.
- Pneumatic rollers checked for general condition and tire pressure and to ensure that they contain ballast to provide the desired weight (Steel wheel rollers are not generally used on maintenance chip seals).
- Water truck for wetting of chips and road surface.
- Towed or self-propelled brooms, which should have adequate, broom cores for the day's work with controls, which are responsive and functional.
- Asphalt distributor.

Materials

Asphalt

Emulsified asphalt is typically used as a binder for chip seal. Emulsions are continually being improved. The most common emulsions currently used have modifiers blended in the asphalt such as CRS2 LM (cationic rapid set 2 with latex modified) or CRS2P (cationic rapid set 2 with polymers). Refineries through annual term-contracts provide emulsion asphalt.

Two asphalt samples shall be obtained from every truck and trailer load. The asphalt transport driver shall take samples. **MDT personnel should not take the samples.**

All samples are to be labeled with appropriate information, including the cost center number identifying the project. Submit samples to the Materials Bureau in Helena within 24 hours.

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Aggregate used for chip sealing is typically Grade 4A crushed top surfacing. Specifications for aggregate are found in Section 701 of the Standard specifications for Road and Bridge Construction Manual. Aggregate for chip seals are usually purchased through a State Maintenance Project (SMP).

Generally, before the job starts, the chips are stockpiled in locations along the route to be sealed, to shorten haul distance and save time. It is important for stockpile location to be on firm ground that is well drained. Safe access to the highway should also be considered. Allow room around the pile for a water truck to wet the chips prior to use on the project. Send an appropriate sample to Materials Lab in Helena for testing and chip design.

Chip Design

See Chapter 1, page 11 in Maintenance Chip Seal Manual, 1996, 2000.

Storage

See Chapter 2 in Maintenance Chip Seal Manual, 1996, 2000

Safety and Training

Supervisors should review safety, training and work zone requirements with employees and ensure compliance with approved guidelines. When doing a chip seal, eye protection should be used, especially for all employees on the roadway.

Special Precautions

Since vehicle window damage is one of the major concerns when chip seals are applied, the following should be avoided:

- Improper sweeping operation.
- Trucks that have chips falling off the loads when traveling to the spreading unit.
- Speeding trucks that may be throwing chips.

The chip seal should be applied in a manner that provides the least inconvenience to the traffic. Piloted traffic should be used during construction. Traffic may be routed over the newly placed chips after they have been rolled, but should be restricted to slow speeds under the control of a pilot car until the binder and chips have set and the surface has been well broomed.

Environmental Best Management Practices

Environmental best management practices include:

- Using water (as needed) to reduce dust during sweeping.
- Storing/disposing materials at an appropriate site. Removed materials may be temporarily stored in a stable location, which prevents the material from entering wetlands or waterways.
- Applying the provisions of the local State Implementation Plan (SIP) in PM10 air quality non-attainment areas.

- Coordinating crews to follow sweeping/flushing with bridge drainage cleaning when feasible.
- Removing swept materials produced from paved surfaces within 25 feet of identified sensitive waters.
- Identifying and placing sediment barriers in site-specific locations along stream routes or directing drainage routes, routing swept material away from surface water where appropriate and if practical.

Procedures

See Chapter 1 and 4 Maintenance Chip Seal Manual. Chip seals should be applied only between May 1-August 31. The road surface temperature must be 65°F and rising. Road Weather Information Sites (RWIS) may provide information on surface temperature and forecast information.

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3.7 Rejuvenating /Fog Seal (MMS 1107)

Activity Description

Work covered under this activity involves applying an emulsion or liquid asphalt to the roadway at a prescribed rate. Sand is applied at intersections, driveways or flush areas to prevent tracking.

Purpose

Fog seals are a preventive maintenance strategy. Fog sealing the pavement surface accomplishes the following:

- Prevents intrusion of moisture into the asphalt surface.
- Retards surface deterioration such as raveling and cracking.
- Improves chip retention on new chip seals.

Timing of Maintenance

Fog seals are used after blade patches or chip seals and as a treatment to be used on an as-needed basis.

Specialized Equipment

- Pneumatic rollers
- Sand spreaders
- Sweepers
- Distributor
- Water trucks
-

Materials

The following materials may be used:

- Emulsions such as SS-1, SS-1h, CSS or CSS-1h.
- Rejuvenating agents.
- Sand to provide non-skid surface.

Testing

An asphalt sample must be obtained from each truck and trailer load of asphalt material. The Materials Bureau performs testing of asphalt material. All emulsion samples must be submitted to the Materials Bureau as soon as possible, preferably the next working day.

Storage

Emulsions are typically not stored through the winter.

Safety and Training

Supervisors should review safety, training and work zone requirements with employees and ensure compliance with approved guidelines.

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Employees should review the MSDS to learn about the product and to make themselves aware of safety and health precautions and required personal protective equipment and clothing.

Special Precautions

The fog seal should be applied in a manner that provides the most convenience for traffic. Piloted traffic should be provided as minimum, until the material has cured sufficiently so it will not pick up or track. The roadway surface should be reviewed prior to the seal to determine if there are any areas where the application of asphalt should vary due to variations in pavement surface texture. If travel lanes are flush sealed, a light application of sand should be applied before the seal sets in order to improve skid resistance.

Environmental Best Practices

Best management practices include:

- Striving to eliminate diesel and solvents as a releasing or cleaning agent by using environmentally sensitive agents.
- Carrying adequate erosion control supplies (diapers, kitty litter, shovels etc) to keep materials out of water bodies.
- Disposing excess materials at appropriate sites.
- Performing surface work in dry weather minimizing runoff of potentially hazardous material.

Procedures

1. Set up traffic control in accordance with Work Zone Guidelines.
2. Prepare area to be sealed. Sweep if necessary and place temporary lane line delineators.
3. Use pilot car, as necessary, to control traffic.
4. Apply emulsions and rejuvenating agent at the prescribed rate based on the surface texture or the pavement and the material selected. Typical application rate is .06-.08 gallons per square yards. Cut emulsion 50% with water.
5. Check application rate of the distributor periodically to ensure the desired amount of asphalt is being applied.
6. Apply a light coating of sand, when flushing occurs, to provide a non-skid surface and prevent tracking.
7. Place signs warning of fresh oil, loose gravel and advisory speed signs at the beginning of the project.
8. Place permanent markings on sealed surfaces as soon as possible.

3.8 Blading and Shaping Gravel Shoulders (MMS 1108)

Activity Description

This activity involves blading, shaping and smoothing gravel shoulders next to paved surface roadways.

Purpose

The purpose of this activity is to help provide smooth riding surface and proper drainage.

Timing of Maintenance

This activity is done when conditions dictate.

Specialized Equipment

- Roller
- Water truck
- Motor patrol
- Loader
- Broom

Materials

- Appropriate aggregate materials mix for unpaved roadway surfaces.
- Magnesium Chloride or acceptable substitute for dust abatement and stabilization.

Safety and Training

When working with motor patrol, use precautions recommended by manufacturer in operations manual. When working with magnesium chloride, follow manufacturer's instruction and MSDS.

Environmental Best Management Practices

Best management practices include:

- Evaluating the specific site for alternatives to blading such as berming, curbing or paving shoulders.
- Evaluating width of the blading activity, where practical and if appropriate, and modifying the width to minimize disturbance of vegetation.
- Blading in dry weather when possible, but while moisture is still present in the soil and aggregate (to minimize dust). Special precautions may be necessary in PM10 air quality non-attainment or high-risk areas.
- Incorporating the activity into the local vegetative management plans considering and minimizing impacts on streams.
- Stabilizing disturbed soil permanently using a BMP (seeding, plant, etc.)

Dust Abatement

Dust abatement for blading and shaping gravel surfaces involves application of dust palliative to non-paved road surfaces to temporally stabilize surface soils leading to a

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reduction of dust during the dry season. Palliatives are applied in liquid form and could include magnesium chloride, emulsified asphalts or lignon sulfonates.

Best management practices include:

- Constructing during preparation for application of dust palliatives, gravel berms at the low shoulders of the roadway to inhibit liquid palliatives from entering surface waters.
- Applying dust palliatives will not be applied during rain.
- Applying methods or materials applied in a manner that is not detrimental to either water or vegetation.
- Carrying adequate spill protection, such as kitty litter, shovels, diapers, etc. Use environmentally sensitive cleaning agents.
- Disposing excess materials at appropriate sites.

Procedures.

1. Set up appropriate traffic control.
2. Blade surface and pull material from shoulder area when enough moisture is present in the surface material.
3. Add aggregate material and level when required.
4. Spray magnesium chloride for stability and dust control.
5. Broom pavement of loose debris.
6. Place appropriate warning signs.
7. Remove traffic control devices.

3.9 Milling and Scarification (MMS 1112)

Activity Description

These activities include removing surface irregularities and deteriorated pavements using a cold planer or motor patrol. Milling is also an appropriate strategy for both asphalt and concrete surfaces to improve ride.

- **Scarification** is used to remove high spots on asphalt pavement. A motor patrol with a variety of cutting edges is used for this work. This is dependent on the extent and severity of the surface problem. Warm surface temperatures are best for this strategy.
- **Milling** is the grinding away of asphalt material from the surface to remove poor material (flushed or raveled), improve ride or prepare a project for an overlay. It is important on the milling machine to establish a profile grade. If a chip seal is planned as a surface treatment after the milling, the surface needs to be very smooth. This can be obtained by slowing the rate of travel on the miller, ensuring the surface temperature is warm and increasing the frequency of milling teeth on the machine.
- **Milling** before an overlay ensures a smooth transition from existing surface to the new pavement. Milling should be done at both ends of the job, bridge approaches, railroad crossings and cattle guards. The standard milling taper lengths are 50 feet –100 feet.

Purpose

Scarification/milling is used to remove high spots on asphalt pavement. Milling is used to remove poor materials (flushed or raveled), improve ride, prepare a project for an overlay or improve skid resistance.

Timing of Maintenance

When surface irregularities and pavement deterioration impacts ride quality, one of the above treatments should be considered to improve the ride.

Specialized Equipment

- Milling machine.
- Motor patrol with appropriate scarification blade.
- Brooms.
- Water truck.
- Cold planer

For large project, the milling is usually contracted out. Other equipment used could be a cold planer where available.

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Safety and Training

Supervisors should review safety, training and work zone requirements with employees and ensure compliance with approved guidelines.

When working around a milling operation, use appropriate eye protection and clothing.

Environmental Best Management Practices

Best management practices include disposing excess materials at an appropriate site.

Procedures

1. Place traffic control and other safety devices.
2. Mill or scarify surface irregularities.
3. Pick up, remove, and dispose of excess material.
4. Remove signs and other safety devices.

3.10 Contract Pavement Preservation (MMS 1301)

Activity Description

This activity is a contracted, thin-lift overlay. A contractor with hot-mix asphalt and a paver completes the work. Contracted overlays are typically 0.15 feet in thickness and are completed using the Maintenance Division's standard overlay contract and may be either preventive or reactive in nature.

Purpose

The purpose of this activity is to preserve or extend the life of the highway pavement surface and to improve safety and road quality.

Timing of Maintenance

Contracted overlays are performed when the ride is undesirable or the roadway is distressed to the point that an overlay is the best maintenance alternative or as a preventive maintenance strategy. Once a contracted overlay has been placed, a chip seal should be placed over it within one year.

Note: Refer to special provisions in Maintenance Pavement Preservation Contract and/or Standard Specifications for Road and Bridge Construction.

Specialized Equipment

All equipment must meet the requirements outlined in the Maintenance Pavement Preservation Contract.

Materials

Materials for contracted overlays may be purchased through a Maintenance Pavement Preservation Contract, Special Maintenance Project (SMP), Materials Purchasing Contract (Purchasing Bureau) or provided by the contractor.

Contracted overlays shall use only Grade B, Modified Grade B (single stockpile) or Grade D aggregate, unless approved by the Maintenance Division Administrator. Only PG asphalts shall be used on contracted overlays. The exact aggregate and liquid PG asphalt will depend on ADT, availability and other factors.

Specifications for aggregate and PG asphalts can be found in the Maintenance Pavement Preservation Contract and/or Standard Specifications for Road and Bridge Construction.

A mix design shall be required before paving can commence.

Testing and Sampling

Aggregates shall be sampled and tested in accordance with frequencies established in the SMP contract and/or Materials Manual. Aggregates must meet the specification outlined in the specific project special provisions.

Two asphalt samples shall be obtained from every truck and trailer load. The asphalt hauler shall take samples. **MDT personnel should not take the samples.**

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All samples are to be labeled with appropriate information, including the cost center number identifying the project. Submit samples to the Materials Bureau in Helena as soon as possible, preferably the next day.

Field verification samples of the aggregate/asphalt mix should be tested to verify the mix design. If there are questions, contact the district lab personnel before making changes.

Storage

Aggregate stockpiles should not impact drainage nor create a traffic or safety hazard. The stockpile should be kept free of contaminants.

Safety and Training

Supervisors should review safety, training and work zone requirements with employees to ensure compliance with approved guidelines.

Special Handling

Both asphalt mix and liquid asphalt materials are used at very high temperature. Special precautions need to be observed:

- Ensure first aid supplies are on site.
- Be aware of exposure to hot materials.
- Take safety precautions when taking samples.
- Wear proper protective clothing when working with hot materials.

Environmental Best Management Practices

Best management practices for asphalt plant production include:

- Striving to eliminate diesel and solvents as a releasing and cleaning agent by using environment sensitive agents.
- Carrying adequate erosion control supplies (diapers, kitty litter, shovels, etc.) to keep material out of water bodies.
- Disposing of excess materials at appropriate sites.
- Ensuring that contractors and MDT staff who fuel and operate asphalt plants have an adequate spill plan and materials for spill containment if possible.
- Establishing mixing plants outside of riparian corridors. The maintenance chief in coordination should review site location with the MDT District Biologist.
- Using commercial asphalt production plants for asphalt supplies where economically feasible.
- Performing surface work in dry weather to minimize runoff of potentially hazardous material when possible.

Procedures

1. Develop contract.
2. Secure mix design.
3. Prepare area to be overlaid (seeping, etc.).
4. Design traffic control.
5. Set up traffic control.
6. Calibrate hot plant.
7. Apply tack coat.
8. Start paving.
9. Check yields, discharge temperatures, etc.
10. Develop roller pattern.
11. Clean up area, dispose of waste.
12. Place temporary pavement markings.
13. Remove traffic control.

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